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From: Ham-Ant Mailing List and Newsgroup <ham-ant@ucsd.edu>
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Today's Topics:

Antenna Tuner Questions (2 msgs)

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Problems you can't solve otherwise to brian@ucsd.edu.

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We trust that readers are intelligent enough to realize that all text
herein consists of personal comments and does not represent the official
policies or positions of any party. Your mileage may vary. So there.

Date: Wed, 15 Dec 1993 16:17:16 GMT
From: news.cerf.net!pagesat!direct!herald.indirect.com!kg7bk@network.ucsd.edu
Subject: Antenna Tuner Questions
To: ham-ant@ucsd.edu

I am teaching a ham class and have been asked questions that I can't
answer (not unusual) but I can't find the answer in the Handbook or
Antenna Book... Here they are:

1. The Handbook says that an antenna tuner's loss is normally less than
0.5 dB. Assuming a 10/1 SWR, is the loss greater when one is matching
a load of $5 + j0$, $500 + j0$, $10 + j50$,...etc.?
2. Which is the best antenna tuner, a T, Pi, Z,...etc.?
3. What is the transfer function of a transmission-line transformer type
Balun? i.e. Does a 4:1 Balun transform $1000 + j1000$ to approximately
 $250 + j250$ or is it like the coax series-section transformer equations?

thanks, Cecil, kg7bk@indirect.com

Date: 15 Dec 93 21:08:47 GMT
From: ogicse!hp-cv!sdd.hp.com!col.hp.com!news.dtc.hp.com!srngenprp!
alanb@network.ucsd.edu
Subject: Antenna Tuner Questions
To: ham-ant@ucsd.edu

Cecil Moore (kg7bk@indirect.com) wrote:

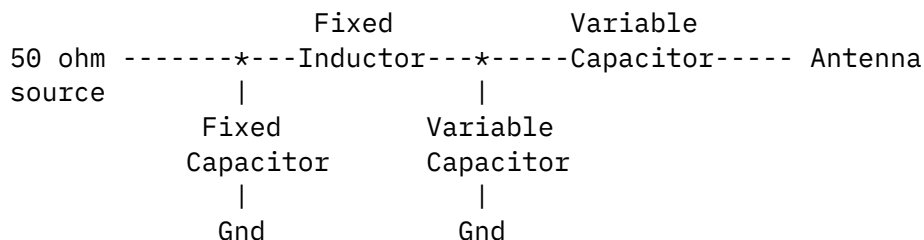
: 1. The Handbook says that an antenna tuner's loss is normally less than
: 0.5 dB. Assuming a 10/1 SWR, is the loss greater when one is matching
: a load of $5 + j0$, $500 + j0$, $10 + j50$,...etc.?

I don't know what "normally" means, but I can tell you that there are plenty of poorly-designed antenna tuners being manufactured with more than 5 dB insertion loss. With most designs, the loss is a strong function of the antenna load impedance. If you measure the loss when "matching" a 50-ohm load, you probably don't get worst-case results.

: 2. Which is the best antenna tuner, a T, Pi, Z,...etc.?

An L-network is the simplest. However, since any antenna tuner requires at least two adjustments (to match the real and imaginary part of the load impedance), an L-network requires that both the capacitor and inductor be adjustable. Since adjustable inductors are harder to make, a Pi or T match is usually preferred.

When I was at Drake, I designed the MN-2700 antenna tuner. Unlike most amateur tuners, it actually has an insertion loss spec (.5 dB) which applies to any load impedance within the tuner's matching range. Matching range is specified at up to 5:1 SWR at any phase angle, although it will typically do much better than that with high (>250 ohm) loads. It uses a type of Pi/T network:



The fixed capacitor and inductor are band-switched. Since there are no variable components between the 50-ohm source and the inductor, the current through it (and thus the loss) are independent of the load impedance when the tuner is adjusted for perfect match. Since the capacitors are nearly lossless, the tuner loss is independent of load impedance. All the Drake tuners (MN-4, MN-2000, MN-7, MN-2700) use this same circuit topology.

: 3. What is the transfer function of a transmission-line transformer type
: Balun? i.e. Does a 4:1 Balun transform $1000 + j1000$ to approximately
: $250 + j250$ or is it like the coax series-section transformer equations?

Theoretically, both the real and imaginary parts are scaled by 4:1.
So yes, $1000 + j1000$ becomes $250 + j250$. However, be aware that most baluns
have stray reactances that become more important with high SWR. Also,
high SWR causes increased current or voltage in the balun for a given
power level: With a 10:1 SWR, for example, current can be as high as
3.16 times the 50-ohm value, so your 1 kw balun is now a 100 watt balun!

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End of Ham-Ant Digest V93 #144
